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STUDIES ON ELECTROMAGNETIC SHIELDING EFFECTIVENESS OF ELECTRICALLY CONDUCTIVE FABRIC

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ABSTRACT

Due to rapid growth of the electronic industry and the widespread use of electronic equipments have led to many electromagnetic interference (EMI) problems like malfunctioning of an electrical circuit and the possibility of cancer. This can be prevented using electromagnetic shielding. Use of textiles as a shielding material gives an advantages of light weight and flexibility as compared to metal screens and the other traditional shielding materials. Many researchers have tried different methods to make textile material electrically conductive for electromagnetic shielding use. PC fabric was made electrically conductive by silver coating of different thickness using plasma technique and electromagnetic shielding effectiveness has been investigated in the present paper. It was observed that with increase in coating thickness, better shielding effectiveness is achieved.

KEYWORDS: Conductive Fabric, Electromagnetic Shielding, Silver Coating, Plasma Technique

INTRODUCTION

The growth of the electronic industry and the widespread use of electronic equipment in communications, computations, automations, biomedicine, space, and other purposes have led to many electromagnetic interference (EMI) problems as systems operate in close proximity. Increased awareness of EMI has led to the formulation of new regulations around the globe for the manufacturers of electrical and electronic equipment to comply with the electromagnetic compatibility requirements.[1]

If an electromagnetic wave enters the human body, it brings abnormal chemical activities to produce cancer cells, and increases the possibility of cancer across all the body organs, brain tumor, breast cancer, leukemia, heart attack, some skin diseases, depression, etc. Injuries by electromagnetic waves to the human body are the top priority of professionals and scholars, and we are most concerned with solving this problem.Shielding can be specified in the terms of reduction in magnetic (and electric) field or plane-wave strength caused by shielding. Shielding effectiveness is normally expressed in decibels (dB) as a function of the logarithm of the ratio of the incident and exit electric (E), magnetic (H), or plane-wave field intensities[2]. PC woven fabric was made electrically conductive by silver coating using plasma and the electromagnetic shielding effectiveness is reported in the present study.

METHODS

Properties of the fabric selected for the study are given in table 1.

Table 1: Properties of the Fabrics

Property	67/33 PC Fabric	83/17 PC Fabric
EPI	88	90
PPI	88	74
GSM	68	76
Thickness	0.17	0.16

Three PC fabric was made electrically conductive by silver coating of 1, 3 and 5 μm with thickness plasma technique. Silver coated and uncoated fabrics are shown in the following figure.

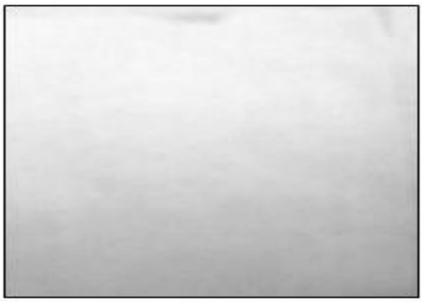

Figure 1: Fabric without Silver Coating **Figure 2: Fabric with Silver Coating**

PC fabric is treated for 1.5, 3 and 5 hours to get 1, 3 and 5 μm thickness of coating. The test was done as per ASTM D4935[3]. The SE is then calculated according to the equation

S.E = 10 log 10 (p1/p2) dB

Where, S.E – shielding effectiveness, P1 – receive power with the material present, P2 – receive power without the material present.

RESULTS AND DISCUSSIONS

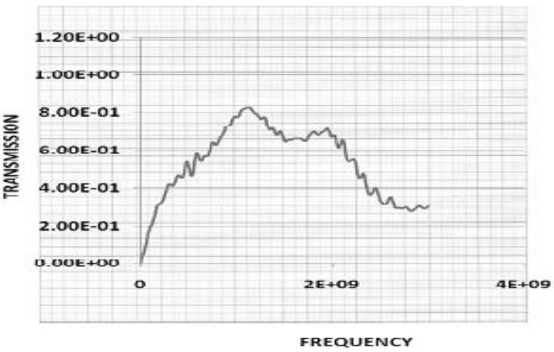

Figure 3: EMSE Test of Fabric without Silver Coating

This graph shows when there is no fabric in between two holder frequency pass there is no shielding taking places means no shielding is done.

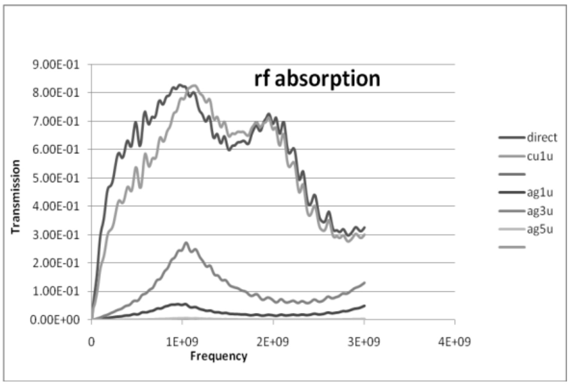

Figure 4: EMSE Test of Fabric with 1,3 And 5 μm Silver Coating

Compare to coating thickness we can see that as the coating thickness increases, the EMSE is also increase.

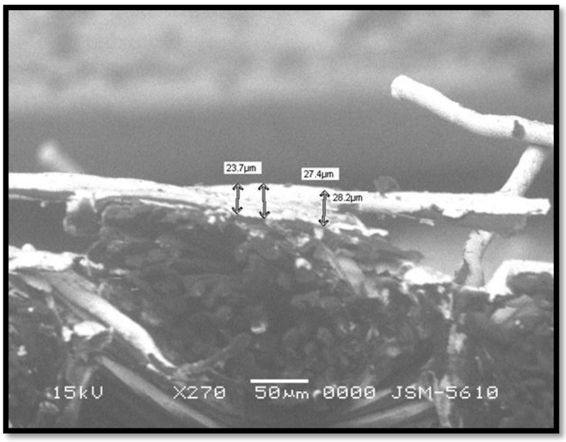

Figure 5: SEM of Silver Coated Fabric

This figure shows the layer of silver on pc blend woven fabric. It is solid and mounted only on surface of the fabric, which not only stems from low surface resistivity, but also from expanded surface of metallic layers.

CONCLUSIONS

Based on the present results, it is concluded that different coating thickness has different effects on its EMSE characteristics. Among the different coating thickness, the 5µm silver coating displayed the highest EMSE. Same results are obtained due to same coating for both the fabrics. i.e. 67/33 PC blend and 83/17 PC blend. From the experiments, it can be clearly seen that thicker coated membranes generally have a higher EMSE. Moreover, the experimental results show that the EMSE correlates linearly with the film thickness. In this experimental work, up to 3GHz frequency of electromagnetic waves was used. However, in reality, electromagnetic waves propagate in multiple directions. It may be better to add metal coating in face and back side of fabric so that the fabric has a more electrical conductive component, easily intercepts electromagnetic waves, and hence has better EMSE can be achieved.

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